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Source: *Journal of Community Health Nursing*, Vol. 2, No. 1 (1985), pp. 31-40
Published by: Taylor & Francis, Ltd.
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JOURNAL OF COMMUNITY HEALTH NURSING, 1985, *2* (1) 31–40
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Chemical Hazards in the Household: What Every Community Health Nurse Should Know

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The use of new chemicals in the home has expanded rapidly over the past 50 years. Community health nurses have a responsibility to be knowledgeable about household products and the health-related hazards associated with their use. In this article, examples of common household chemicals, factors relating to accidental poisoning, toxic effects of ingesting household chemicals, and medical management of poison victims are examined. The role of the community health nurse in educating the consumer in the home environment on packaging, storage, toxicity, and utilization of household products is presented.

In the last 50 years, with the increased use of synthetic chemicals, thousands of new products have flooded into American homes. Chemicals are used in medical treatment, pest and disease vector control, food processing and packaging, cosmetics, and housekeeping supplies, just to name a few. As more synthetic chemicals are introduced into the consumer marketplace, the risk of health hazards associated with product use also rises. Poisoning and other health problems develop as a result of incorrect use of chemicals in the home. Consumers have limited knowledge about the contents and proper storage of hazardous chemicals. This compounds the potential health hazards associated with a lack of product testing related to irritant and allergic reactions from product use. Community health nurses have access to the home environment, where interaction with consumers is conducive toward providing education on the use of chemicals. In this article, factors relating to poisonings, examples of household products, toxic effects, and treatments are explored. Health education strategies that can be used by the community health nurse are suggested.

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POISONING AND HOUSEHOLD PRODUCT USE

The National Poison Information Service in London, which provides information only to the medical profession, received 25,000 inquiries relating to poison information in 1977. Of these calls, 30% were related to poisonings with household products. Similarly, in 1976, the American National Clearinghouse for Poison Control Centers reported that 32% of the 147,000 inquiries they received from the medical profession and the public involved household products (Meredith & Vale, 1978).

Ingestion of household products is the most common means of poisoning. Accidental ingestion is related to a combination of an inexperienced, unknowledgeable person; potentially harmful agents; and an unsafe environment (Meredith & Vale, 1978). A young child will explore the home environment and find potentially toxic substances stored under the sink, in the medicine cabinet, in the garage, or in the cellar. The quantity consumed and the toxicity of a particular product will determine the necessary treatment of a poison victim. Household products in liquid or pellet form, with pleasant smells and flavors, stored in large volumes, or with low viscosity, are more hazardous to a child because of the potential for a larger amount to be ingested. Conversely, solids or powders limit the amount ingested; unpleasant flavors discourage swallowing of more than a mouthful; and smaller volumes limit the potential for a toxic dose to be available for consumption (Meredith & Vale, 1978).

Several studies that identify factors relating to poisonings from household products have been conducted. Poisoning occurs most frequently in the 0–5 age bracket with bleach, perfumes, lavatory cleaners, and dishwashing powders and liquids leading the list of common household products ingested or inhaled by this age group (Durham, 1979; Edwards, Jenkins, & Volans, 1982; Lovejoy, Flowers, & McGuigan, 1979; Meredith & Vale, 1978; Temple & Veltri, 1979). Youths in the 6–12 age range commonly ingest gasoline or paint, whereas the 13–20-year-old ingests alcohol or gasoline, which typically is associated with a suicide attempt (Lovejoy et al., 1979). Many adults over the age of 20 are poisoned through accidentally inhaling gaseous products from the combination of bleach and ammonia, or ingesting ammonia, bleach, alcohol, or lavatory cleaners in large amounts in suicide attempts (Durham, 1979; Lovejoy et al., 1979). Symptoms or side effects were reported in 2% to 40% of the poison victims, with the most common side effect being gastrointestinal problems (Lovejoy et al., 1979; Meredith & Vale, 1978; Temple & Veltri, 1979).

Serious complications involving hospitalizations and deaths have been reported. In a study by Temple and Veltri (1979), out of 750 reported poisonings in 1 year, 45 poison victims were hospitalized due to ingesting automatic dishwashing powder. Another study reported hospitalizations from ingesting bleach or lavatory cleaners in 40% of the 300 victims surveyed (Edwards et al., 1982). The deaths reported were from the poisonings related to adults suffering caustic burns, secondary to ingesting large amounts of bleach or lavatory cleaners (Durham, 1979).

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HOUSEHOLD CHEMICALS

Bleach and Ammonia

The major chemical components of household products are classified as acids, alkalies, bleaches, detergents, and alcohols. Bleach is composed of 3% to 6% sodium hypochlorite. When ingested, a burning sensation develops in the mouth, throat, and stomach. If swallowed in large amounts, the hypochlorite reacts with hydrochloric acid in the stomach and releases chlorine gas that produces severe gastric irritation. Chlorine gas is released from the stomach and, when inhaled, causes pulmonary edema and severe irritation of the oral and nasal mucosae (Meredith & Vale, 1978). Accidental poisoning by inhalation occurs when bleach is mixed with ammonia or toilet cleaners during household cleaning. Bleach mixed with ammonia (ammonium hydroxide) results in the release of chloramine gas. The release of the gas in a small, poorly-ventilated room produces nausea, respiratory irritation, and in severe cases, pneumonitis (Gapany-Gapanavicius, Malho, & Tirosh, 1982). When bleach is combined with toilet cleaners (sulfuric or hydrochloric acid), chlorine gas and sulfur oxides develop. The synergistic effects of these gases may be severe respiratory irritation and pulmonary edema (Meredith & Vale, 1978).

Acids and Alkalies

Acids and alkalies exist in varying concentrations in household products. Sodium hydroxide is a strong alkali and is a principle component of common products such as Liquid Drano (9.5% concentration), granular Drano (80% concentration), Easy-Off liquid, and Mr. Muscle aerosol oven cleaners (Range, Hirokawa, & Bryarly, 1983). Strong acids include products like Mister Plumber (sulfuric acid), Lysol toilet bowl cleaner (hydrochloric acid, 8.5% concentration), Zud rust and stain remover (oxalic acid), Saniflush granular toilet bowl cleaner (sodium bisulfate, 75% concentration), and kitchen descalers containing formic acid (Range et al., 1983).

Health problems develop when the compounds are ingested or inhaled in large amounts. Liquid products have an average of 8% to 10% or higher concentration of acids or alkalies, whereas solids may average 75% to 80% concentration. Although solids have a higher concentration of caustic acids or alkalies, usually a smaller amount is ingested. The ingestion of large amounts of liquids is associated with a greater risk of ulceration or perforation in the lower esophagus or stomach. Corrosive acids cause more tissue damage in the stomach when ingested due to the alkali buffering effect of the esophagus and the potentiating effect of the hydrochloric acid in the stomach. Alkalies combine with protein to produce proteinates, which form soap when combined with fat. Ingesting alkalies causes greater damage to the esophagus. If the formation of an alkali soap lining occurs in the esophagus, the solubility of the al-

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kali makes possible continued necrosis, ulceration, and potential perforation of the esophagus (Meredith & Vale, 1978).

Treatment following the ingestion of bleach, acids, or alkalies is symptomatic. Demulcents (i.e., activated charcoal) are frequently used, whereas gastric lavage and emetics are prohibited (Meredith & Vale, 1978). Community health nurses can advise consumers to attempt to neutralize the caustic effects of acids with milk and water, and for alkalies, use a vinegar and water solution to neutralize the esophagus (Range et al., 1983). A call to a poison control center or a local emergency room can provide additional guidance on the treatment needed for a specific product. Endoscopy is often performed following a large ingestion of bleach, alkalies, or acids to evaluate for damage to the alimentary tract. Even when oral burns are not evident, lower esophageal injury may be present. The possible complication of esophageal stricture must be closely monitored in cases of lower esophageal tissue necrosis (Range et al., 1983).

Surfactants and Formaldehyde

Laundry, soil and floor cleaning agents, and dishwashing products contain chemicals that can be hazardous if ingested or cause skin allergies and irritation with skin contact. Surfactants are divided into anionic, nonionic, and cationic groups. Cationic surfactants are sometimes found in disinfectants and detergents, but are rarely used in household products due to their toxicity. Anionic surfactants cause skin irritation by combining with the natural oil on the skin surface to produce skin irritation, soreness, and papular dermatitis. When ingested, they produce gastrointestinal problems. Nonionic surfactants are less toxic and produce only slight irritation of the skin and no harmful side effects with ingestion. Products containing anionic and nonionic surfactants include carpet shampoo, dishwashing liquid, and rinse products, fabric softeners, and laundry detergents (Meredith & Vale, 1978). A common skin irritant, which plagues many housewives, is formaldehyde. Many household products, including detergents, dishwashing liquids, woolen and fine linen washing agents, and furniture polishes contain formaldehyde (Lachapelle & Tennstedt, 1981). Other household goods with the potential for exposing the consumer to formaldehyde might include new carpeting, furniture, or drapes.

Silicates and Metasilicates

The misuse of laundry powders and dishwashing liquids is a common problem in households. One study reported a 65-year-old woman using dishwashing liquid for an enema (Velart, 1979). Severe bloody diarrhea is a common side effect of ingesting laundry detergents or dishwashing products (Meredith & Vale, 1978). Silicates and metasilicates found in automatic dishwashing machine powders are the most caustic of the detergent group. Following ingestion, severe vomiting ensues with the potential for aspiration leading to bronchopneumonia. Bloody diarrhea, high fever, and inspir-

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atory stridor are common side effects that develop from ingesting large amounts of automatic dishwashing powders. Penetrating lesions in the alimentary tract may appear, which resemble those caused by sodium hydroxide ingestion (Velart, 1979). Treatment following ingestion of automatic dishwashing powder consists of forcing fluids when small amounts are involved, and gastric lavage, hospitilization, and close monitoring when large amounts are swallowed (Meredith & Vale, 1978).

Alcohols

Alcohols are another group of common chemicals found in the home. Ethanol is the solvent for perfume, cologne, after shave, and mouthwash. The Massachusetts Poison Control Center reported that of 1,780 incidences of poisonings, exposures to the ingestion of colognes and perfumes constituted 20.8% of the inquiries (Lovejoy et al., 1979). The ingredients of perfume are essentially oils for fragrance and a varying percentage of ethanol. When perfume is ingested, a burning sensation, gagging, and coughing develop. The amount of perfume consumed is usually very small, so severe health effects are rare. The ingestion of amounts greater than 30 ml requires gastric lavage (Meredith & Vale, 1978).

Mouthwashes, common household products that are accessible to young children, are not stored in containers with child-proof lids and are not treated as hazardous medicine in many homes. The bright colors, good taste, and liquid form tempt young children and, therefore, large amounts may be ingested. The ethanol content of mouthwash is between 14% and 26.9% in the five leading brands, which constitute 95% of the market (Weller-Fahy, Berger, & Troutman, 1980). The toxic effects of ethanol consumption in young children may include a severe hypoglycemic reaction that, if not treated promptly, can result in death. Treatment may include lavage, intravenous therapy, and combating hypothermia. Mouthwash is classified as a cosmetic by the Food, Drug, and Cosmetic Act and, therefore, it is not under the jurisdiction of the Bureau of Alcohol, Tobacco, and Firearms in the Department of the Treasury. As a result, no specifications for child-proof packaging or percentage of ethanol content are mandated under federal law (Weller-Fahy et al., 1980).

Isopropyl alcohol is the solvent for window cleaning products, disinfectants, and antiseptic solutions. Ingestion of small amounts of isopropyl alcohol can result in death. For instance, ingestion of 100 ml will cause the death of an adult. As little as 2–3 ml will require gastric lavage in a child (Meredith & Vale, 1978). Rubbing alcohol, which is found in most household bathrooms, is not packaged with child-proof lids and is stored in places very accessible to young children. Another alcohol in this group of chemicals is ethylene glycol. This colorless liquid is used in detergents, paints, lacquers, polishes, and solar collecting systems (Scherger, Wruk, Linden, & Rumach, 1983). The most familiar product containing ethylene glycol is antifreeze. The pretty color and sweet taste attract young children and large amounts may be ingested. The onset of symptoms usually occurs several hours after ingestion. The treatment of anti-

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freeze ingestion is to give Syrup of Ipecac, followed by large amounts of water, and a prompt visit to the emergency room. Thirty minutes to 12 hours after ingestion, ataxia, slurred speech, nausea, and vomiting may develop. With increased ingestion and lack of proper treatment, coma, convulsions, and death will occur. Hospitalization may be required to monitor the victim for signs of respiratory distress and pulmonary edema (Scherger et al., 1983).

Turpentine and Gasoline

Turpentine and other petroleum-based products are frequently found in work areas of the home, such as garages and basements. Many of these products are marketed in containers without child-proof lids, are stored in receptacles other than the original labeled container, and are left in places accessible to young children. The lower viscosity of turpentine or gasoline increases the risk of larger amounts being ingested. Ingestion of large quantities may produce chemical pneumonitis and pneumonia (Meredith & Vale, 1978). Inhalation exposure to gasoline vapors is usually limited to short periods of time and is typically not harmful. Benzene and other aromatic hydrocarbons in gasoline attract the consumer or child, who may like to inhale the pleasant scent. The present concentration of hydrocarbons and the period of exposure determine the toxic effects of the gasoline. Prolonged exposure to gasoline vapors may produce symptoms of dizziness, coma, collapse, and eventual death. Stopping the accidental leakage of fumes through the use of tightly sealed, properly stored safety containers and avoiding exposure can prevent the toxic effects (Cornish, 1975).

Methylene Chloride

Other household products stored and used in work areas in the home are paint removers, degreasing solvents, and aerosol propellants, which all may contain methylene chloride. Paint remover used in wood-working is often applied in a poorly ventilated room or enclosed work area. Exposure to methylene chloride for a period of 1 hour or more causes the blood carboxyhemoglobin level (COHb) to rise. Methylene chloride absorbed into the blood system is converted to carbon monoxide. "Exposure to paint remover by an individual with heart disease at a saturation level of 5% to 10% COHb can cause symptoms of angina pectoris" (Stewart & Hake, 1976, p. 400). Another individual at risk is a heavy smoker who may have an existing COHb saturation level of 10%. Limiting the exposure time and using products in well-ventilated rooms would decrease the risk associated with using products containing methyl chloride.

Lead

Exposure to lead poisoning can occur in many different ways in the home. Community health nurses may think of young children eating lead-based paint chips found in

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older homes, especially in poverty stricken areas, or of the pica-eating habits of some minority groups. Other forms of exposure may not be as well-known. Fischbein et al. (1981) reported two cases of homeowners who experienced symptoms of lead poisoning after steaming old paint from the walls of their 19th-century homes. Measurements of the home environments indicated exposure levels of 150 micrograms per cubic meter; Occupational Health and Safety Administration (OSHA) standards are 50 micrograms per cubic meter inorganic lead. Another source of exposure may be through the use of hair dyes. Lead acetate, a compound found in many over-the-counter hair dyes, can penetrate through the skin, be absorbed, and accumulate in target organs, including bones, kidneys, and hair (Marzulli, Watlington, & Maibach, 1978). The amount of lead acetate absorbed and the risks of exposure are still being determined. Signs and symptoms of lead poisoning are frequent headaches, irritability, and gastrointestinal problems. Progressive symptoms include a lead line at the margin of the gums and indications of neuropathy or encephalopathy (Marzulli et al., 1978). Treatment of lead poisoning entails the administration of a chelating (metal ion bonding) agent such as calcium EDTA.

CONSUMER PROTECTION

Federal legislation that gives consumers some information and reduces the risks associated with the use of household products has been passed. An amendment to the Federal Food, Drug, and Cosmetic Act (FDCA), passed in 1976, provides for the testing of drugs before they are marketed and requires presentation of data to the Food and Drug Administration (FDA) to show evidence of the efficacy and toxic side effects involved with each new drug. The FDA also establishes and monitors food standards relating to color and flavor additives and food processing. The FDCA called for standards to be promulgated on cosmetics. Based on research, the FDA has restricted or prohibited the use of chemicals such as vinyl chloride in aerosol products, chlorofluorocarbon propellents, and mercury-based cosmetics in response to the identification of health hazards associated with their use (Code of Federal Regulations, Title 21, Parts 600–799, 1983). One limitation to the FDCA covering cosmetics is that labeling and filing of product ingredients is left up to the voluntary compliance of manufacturers (Code of Federal Regulations, Title 21, Parts 600–799, 1983).

The Federal Caustic Poison Act (FCPA) and the Federal Hazardous Substances Labeling Act (FHSLA), both passed in 1976, required that household products covered within the jurisdiction of the laws have a clearly marked label. The label must state in large letters "POISON" and must list the exact ingredients, the name and address of the manufacturer, the recommended medical treatment if the product is ingested, and directions for proper use and storage (Code of Federal Regulations, Title 21, Parts 800–1299, 1983). The FCPA requires that certain products have child-proof packaging, but many household products do not fall into this category of caustic poisons.

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Title 27 of the Code of Federal Regulations, enforced under the Bureau of Alcohol, Tobacco Products, and Firearms, controls the quantity, quality, and formulas of many denatured alcohol products used in the home. Products such as antifreeze must be packaged in volumes of less than 1 gallon, bear labels with the manfuacturer's name and address, and include information similar to that listed in the FCPA (Code of Federal Regulations, Title 27, Parts 200 to end, 1983).

The number of poisonings has decreased over the past decade. One reason for this decrease is legislation requiring the manufacturing and sale of less concentrated corrosive household products (Range et al., 1983). For instance, granular toilet bowl cleaners (sodium bisulfate) are now coated with paraffin to prevent immediate solubility in water. This allows time for treatment by lavage to decrease the harmful effects from ingestion (Velart, 1979). A second reason for the decrease in poisonings is related to the increase in safety packaging used for commercial products. Consumer outrage following the poisonings involving Tylenol in February of 1983 influenced Congress to pass resolutions calling for medications, cosmetics, and similar products to be packaged in tamper-resistant containers. Many companies have voluntarily introduced new packaging to comply with these recommended safety standards.

A study conducted by the Poison Information Center in Vienna tested consumer knowledge of the toxicity of household products. The results of 300 people surveyed, who stated these products were either non-toxic or did not know the toxicity, are as follows: 42%, dishwashing detergent; 36%, decalcifiers; 17.6%, drain cleaners; and 44.6%, oven cleaners (Lenz, Hruby, & Jaschke, 1979).

The Intermountain Regional Poison Center in Salt Lake City gathered statistics on the product use status and packaging at the time of exposure to the poisoning. Their review of 711 cases revealed the product in the original container constituted 54% of the cases, whereas 46% were stored in an unlabeled container. Seventy-two percent of the poisonings occurred while the household product was in use, 23.8% in storage, and 2.6% after discarding products (Temple & Veltri, 1979).

The best protection against poisonings and other health problems associated with the use of household products is knowledgeable consumers. All community health nurses have the opportunity to educate clients in their home environment, where the risk of developing health problems from exposure to chemicals in household products is the highest. Educational strategies can be focused on four areas: packaging, storage, toxicity, and utilization of household products. Consumers can be urged to buy products that are clearly labeled with ingredients, directions for use, and harmful side effects. When young children are in the home, preference for buying products with child-proof packaging can be encouraged. Knowledge of the forms of products known to decrease the risk of severe poisoning should be shared with the consumer. Points to emphasize include: the use of solids or granular products rather than liquids, buying smaller quantities of toxic products, and eliminating from the home or reducing a child's accessibility to pleasant tasting or smelling toxic substances.

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Inspection of the home environment provides the community health nurse with information needed to assess and teach consumers about storage, toxicity, and use of household products. Common household agents like bleach, ammonia, and automatic dishwashing powder are frequently stored in areas accessible to young children. Overzealous housekeepers often mix bleach and other cleaning agents without understanding the health risks associated with combining these chemicals. Products like turpentine are often poured from the original container and stored on shelves after use. Storing household products in locked areas out of reach of young children, keeping products in original containers, and eliminating the habit of combining cleaning agents should be emphasized to the consumer.

Teaching the consumer to read the label on household products and to follow directions for proper product use would eliminate many cases of accidental poisoning. The toxicity of products is often referred to on the label. Eliminating unnecessary toxic substances from the home by substituting nontoxic products or by discarding leftover products after use can be encouraged by the community health nurse. Community programs exist where stickers with a frowning face are placed on toxic substances in the home and children can be taught to recognize the symbol on harmful products. Community health nurses should be aware of these programs in their community. Poison Control Center numbers should be given to the consumer and posted near the phone with other emergency numbers.

If a case of accidental poisoning occurs in the home, the consumer should be instructed to read the label on the product, and call the poison control center number before going to the emergency room. Often the poison control center can provide valuable information that can be used at home. Prompt treatment following a poisoning can be facilitated in this manner. Every home with young children should have Syrup of Ipecac in the medicine cabinet in case of accidental poisoning.

Knowledge of what to do in cases of accidental poisoning from caustic acids, alkalies, detergents, and so on, should be shared with the consumer. By teaching the consumer to ask questions before using products, to follow directions and use protective equipment, to store products safely, and to buy products knowledgeably, the community health nurse can contribute to the safety and health of the consumer.

For more information on poisoning, contact your regional or local poison control center.

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